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REVIEW OF PUBLISHED INFORMATION ON THE LARCH-DOUGLASFIR TYPE

by

Russell K. LeBarron

- Northern -
Rocky Mountain
Forest & Range
Experiment Station
Missoula Montana

Chas. L. Tebbe, Director

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INTRODUCTION

Within recent years, foresters of the Inland Empire have become increasingly interested in silvicultural and forest management practices for the larch-Douglasfir type. This interest is a direct result of greater demand for wood products from western larch and inland Douglasfir. The purpose of this report is to summarize available information on the type, partly for forest managers, and partly as a preliminary step in initiating research in the larch-Douglasfir type by the Western Montana Research Center, a unit of the Northern Rocky Mountain Forest and Range Experiment Station.

Probably less formal research has been conducted in the larch-Douglasfir forest type of the northern Rocky Mountain region than in any forest type of equal commercial importance in the United States. Yet it has been given more attention by foresters than is commonly realized.

Search for published literature and unpublished file reports has revealed a considerable store of information. A list of this material showing authors, sources, and dates is given at the end of this report. It will be noted that the reports go back as far as 1911 and that the majority of them are dated from 1912 to 1925. Evidently this was a time when there was much greater interest in larch-Douglasfir type than during the period following 1925. It will also be noticed that the authors of many of the reports include foresters who are widely recognized for outstanding professional skill.

The research work in larch-Douglasfir type which is being conducted currently by the Experiment Station is not discussed in this report. The new material will be released from time to time whenever information suitable for publication is obtained. One such report, "A Preliminary Classification of Tree Vigor for Western Larch and Douglas-fir Trees in Western Montana", Research Note No. 66, was issued in November, 1948. Other current projects include investigations of trends in species composition and growth of residual trees after cutting, and experiments with kinds of cutting and soil preparation to encourage regeneration.

USES

Utilization is described briefly here because it has a strong bearing on logging and management practices.

The woods of larch and the inland form of Douglasfir are similar. For most uses, they are mixed indiscriminately and are sold as "fir and larch". However, larch grows taller, larger in diameter, and prunes better. Consequently, it furnishes the greater proportion of straight-grained, clear material. Both species have been, and still are, used extensively for railway crossties, mine timbers, dimension stock and common lumber. Considerable clear, straight-grained larch is manufactured into flooring. Within recent years, some pole-size larch and Douglasfir have been used for transmission poles. It has been demonstrated that large, surface-clear larch logs can yield an excellent quality of plywood veneer. Both larch and Douglasfir have been used successfully for paper pulp, but to date there have been no substantial quantities taken for this purpose in the northern Rockies.

Small Douglasfir trees from the Inland Empire are cut in great numbers for Christmas trees 1/.

The cut of larch and Douglasfir in Montana generally amounted to about half of the total lumber production in the State during the 36-year period from 1911 to 1946, inclusive. (Table 1.) During the decade 1931-1940, both the percentage of larch and Douglasfir and the total cuts of these species fell off substantially, but recently they have more than regained their former importance.

1/ For a discussion of Christmas tree culture, see Management Practices for Christmas Tree Production, by C. A. Wellner and A. L. Roe, Station Paper No. 9, Northern Rocky Mountain Forest and Range Experiment Station, 1947. Annual production statistics for Christmas trees in Montana are contained in Research Notes issued by the Division of Forest Economics, Northern Rocky Mountain Forest and Range Experiment Station.

On the average, the production of larch has substantially exceeded that of Douglasfir.

Table 1.--Average annual cut of larch and Douglasfir lumber in Montana

Period	Larch	Douglasfir	Larch and Douglasfir	All species
	MM ft. BM	MM ft. BM	MM ft. BM	MM ft. BM
1911 - 20	118	45	164	327
1921 - 30	116	63	179	354
1931 - 40	55	38	93	226
1941 - 46	124	86	210	406

PAST CUTTING PRACTICES

Larch-Douglasfir stands that have been logged in the past usually contained from 10,000 to 40,000 ft. B.M. per acre in merchantable trees. Generally, cutting has resulted in leaving only a small fraction of the merchantable volume. Even on the so-called "partial" or "selective" cuttings, the residual stands ordinarily contained only from 1000 to 2000 ft. B.M. per acre. It is true that occasionally, up to 20,000 or 25,000 bd. ft. per acre were left, but such instances are exceptional. They usually were the result of cutting for a special product, particularly railway ties.

Most larch-fir stands contain a good many undersize and cull Douglasfir, lodgepole pine, spruce and other kinds of trees. Ordinarily these have been left because they could be removed only at a loss. Thus, economic considerations have assisted in bringing about a change in species composition of the type.

SUMMARY OF EARLIER REPORTS

The summary that follows is made as brief as possible without sacrifice of essential information. In most instances, specific sources are not cited. For those who wish greater detail, it can largely be obtained from published and generally available bulletins, books, and periodicals listed in the bibliography. 2/

2/ The unpublished reports listed in the bibliography cannot be sent away from the files, but are available for examination in the Forest Service offices at Missoula.

SILVICAL CHARACTERISTICS

Western larch is long-lived, very intolerant of shade, and resistant to fire. It is the fastest growing tree in the region in the juvenile stage, but after 50 years, growth slows down considerably. When the trees reach the age of 100 to 150 years, further growth is usually exceedingly slow. In general, larch thrives best on the cooler aspects - northerly slopes and benches. Its best growth is attained on relatively deep and fertile soils.

Larch is one of the first tree species to seed in after severe forest fires. In fact, it is clearly a fire species that ordinarily can exist in competition with more tolerant trees for only one forest cover cycle. Periodic removal of tree cover, as by forest fires, is required to permit establishment of a new generation.

Seedlings become established successfully on a variety of surface materials, particularly bare mineral soil and ashes. Some shade to protect tender seedlings from excessive solar heat and drought probably is beneficial, but when well started, the young trees grow best in full sunlight.

Occurrence of seed crops is rather irregular.

Douglasfir is relatively short-lived where it grows in association with larch, somewhat more shade tolerant, and somewhat less fire resistant. Douglasfir may seed in at the same time as larch, or invade young larch stands more slowly following forest fires. Its early growth is slower. Larch maintains the superior position in height throughout the life of a stand. When mixed stands of larch and Douglasfir are thinned by fire, by reduction in numbers of stems from natural causes, or by logging, Douglasfir reseeds more readily. Douglasfir frequently forms dense thickets of advance growth, even under rather heavy stands of larch.

Douglasfir bears abundant seed crops more frequently than larch.

Both species are attacked and suffer serious injury from needle diseases, defoliating insects, wood-rotting organisms, dwarf mistletoe, and a number of other parasitic agents. On the other hand, they suffer little injury from wind. They are considered relatively wind-firm trees, especially larch.

Other trees that are common associates in the larch-fir type include lodgepole pine, ponderosa pine, grand fir, alpine fir, and spruce. Where western white pine is reasonably abundant in association with larch and Douglasfir, the type is designated "western white pine type." The habitat requirements of larch and white pine are similar in many respects.

Despite the even-aged condition of larch-Douglasfir stands at the time of origin, most mature and overmature stands are decidedly uneven-aged. This results from mortality caused by fires or other agents, followed by seeding in of younger age-classes. Some stands have a distinctly two- or three-storied appearance.

RECOMMENDATIONS FOR SILVICULTURAL PRACTICES

Cutting Methods

Local writers among the various earlier foresters who studied the larch-fir type regarded larch as the preferred species much as at present. Most recommendations followed the same pattern, although some individual variations occurred.

Mason advocated reserving 25 to 30 percent of the volume for future growth and seed production in stands over 150 years old. He suggested that cuttings be arranged in the form of a patchwork pattern of cleared spots from one-fourth to one acre in size, intermingled with selectively cut areas. The clean-cut patches should be located in spots that have no advance reproduction. The most defective and the largest trees should be cut. He recommended cutting only 10 to 30 percent of the volume in younger stands.

Koch and Cunningham, although emphasizing the difficulty of generalizing, stated that (a) cutting to a 14-inch diameter limit usually leaves the forest in reasonably productive condition, and (b) a higher order of management requires that decision on cutting in the typical uneven-aged stands be left to the discretion of the marker. Selection cutting of the larger mature trees should be the general guide. They further suggested that larger trees should be cut to a diameter of 14 to 20 inches. It was estimated that the reserve should usually amount to 10 to 30 percent. They advocated thinning in over-dense groups of 12- to 16-inch diameter trees.

Larsen, in a study aimed at harvesting ties as a thinning measure, recommended such thinnings for dense immature and mature stands, but stated that in overmature and decadent stands, the younger trees of sizes suitable for ties should be reserved for future growth.

A joint report by Preston, Larsen, Whitney, and Lowdermilk made the following recommendations for cutting in larch-Douglasfir type:

(1) In all-aged stands, immature even-aged stands, and mature even-aged stands with more than 50 trees per acre below merchantable size, make a selection cutting that will leave more than 50 sound, thrifty trees per acre, 6 inches d.b.h. and over. At least half of the reserve trees should be of the more desirable species.

(2) In other stands, clean cut, leaving seed trees at the rate of two per acre, 12 inches to 16 inches d.b.h. Defective and undesirable residual trees should be cut or destroyed. On severe sites, reserve five seed trees per acre, and on moist sites leave five groups of 8 to 15 trees per 10 acres.

Where advance growth of Douglasfir or more desirable species is present, it should be protected, and seed trees should be required only in openings.

Latane suggested a seed tree method or a flexible diameter limit.

The Region One timber management instructions for larch-fir type, which were prepared in 1924, go into considerable detail.

A summary of the major recommendations follows:

(1) Immature, even-aged stands (less than 120 years). Thin from below.

(2) Mature even-aged stands (120 - 140 years). Clean cut except reserve two to six thrifty, wind-firm seed trees per acre.

(3) Uneven-aged stands (80 to 90 percent of the merchantable stands). A high degree of judgment must be used by the marker. In general, the object will be to make a selection cutting to remove larger and mature trees. If reproduction is complete, all mature trees will be cut. Percentage of merchantable stand to be left will usually range from 10 to 30 percent.

It should be noticed particularly that all of the above recommendations, except as they apply to immature stands, indicate very heavy cutting despite some use of the term "selection".

No one expressed any opinions as to when the second cutting might be made, or what should be taken in the second cutting.

Textbooks of applied silviculture have closely followed the recommendations given in "Timber Growing and Logging Practice in the Western White Pine and Larch-Fir Forests of the Northern Rocky Mountains".

In 1944, a committee composed of representatives of the staffs of the Northern Region, U. S. Forest Service, and of the Northern Rocky Mountain Forest and Range Experiment Station drafted "Tentative Rules of Forest Practice for the Private Forest Lands in the Northern Rocky Mountain Region". These proposed practice rules included recommendations for the larch-Douglasfir type. The essence of them is as follows:

1. Immature stands (generally under 120 years).

   Improvement thinnings that will leave vigorous trees of desirable species. Reserve at least 40 percent of the volume of the larch and Douglasfir trees 12 inches d.b.h. and larger.

2. Mature and overmature stands (over 120 years in age).

   a. Leave all thrifty larch, Douglasfir, Engelmann spruce, ponderosa pine and white pine trees 14 inches d.b.h. and smaller. If not fully stocked with above, leave two to four larger larch and Douglasfir trees per acre.

   b. If two-storied -
      (1) with thrifty, well-stocked understory of young growth - clear cut the overstory.
      (2) with badly suppressed understory - leave at least four 20-inch d.b.h. or larger larch, Douglasfir, or ponderosa pine seed trees, and broadcast burn the slash.

Regeneration Following Logging

Most of the writers were in full agreement that as a rule larch needs rather full sunlight to become established and grow readily. The recommendations for clear cutting with seed trees or heavy "selection" cutting undoubtedly were influenced by the desire to

reproduce larch. Mason and several later writers suggested felling all the tops into openings up to one acre in size and broadcast burning the logging debris in order to create conditions favorable to larch and unfavorable to the more shade-tolerant species. The 1944 committee advised wholesale broadcast burning under certain conditions.

There were suggestions to mark the Douglasfir and lodgepole pine trees down to smaller sizes for removal by loggers and to require cutting or girdling of small alpine fir to retard seed production by the less desirable tree species.

Planting has been suggested for large clearings, although most investigators appeared to believe that cut-over areas are apt to regenerate naturally.

Stand Improvement Measures

The only specific stand improvement measure advocated for mature stands, in connection with harvesting operations, was removal of trees of undesirable species to cut down seed production. Under the broader usage of "stand improvement" as applied by the U.S. Forest Service today to sale area betterment operations, broadcast burning of slash in cleared areas, and planting of large cleared areas can be regarded as stand improvement measures. These proposals have been mentioned in the section Regeneration Following Logging.

Mechanical disturbance of the forest floor for improvement of seedbed conditions, pruning for quality, and cleaning, were not discussed.

Weir pointed out in several published articles that he considered dwarf mistletoe to be an extremely serious pest to larch and Douglasfir, and suggested control measures including clear cutting, destroying cull trees left after logging, and possibly pruning. He believed elimination of infected host trees to be the only way to protect new reproduction from serious infection.

Slash Disposal

Most writers advocated either partial or complete elimination of logging slash by hand piling and burning. The purpose of such slash disposal, of course, was reduction of fire hazard. Broadcast burning clear-cut areas to favor reseeding by larch is the only other method that has been suggested.

COMMENTS

The observations on basic silvics of larch and Douglasfir and recommended silvicultural practices for the larch-Douglasfir type show a considerable degree of consistency. There is rather general agreement on the following points:

1. Western larch is the more desirable species to maintain.
2. Larch is very intolerant of shade. Its more shade-tolerant associates tend to succeed it.
3. Stands are mature at around 120 to 150 years.
4. Clear cutting with seed trees, or heavy cutting with reservation of not to exceed 30 percent of the volume are the most common recommendations for mature and overmature stands.
5. Improvement cuttings or commercial thinnings are suggested for immature stands.

Today there is still little disagreement with most of the principles and proposals that have been briefly described, particularly items 1, 2, 3, and 5, above. Larch is still the preferred species. We believe it requires much sunlight for successful establishment and best growth. Douglasfir and more tolerant species encroach upon it and tend to replace it. Growth of most larch trees more than 120 to 140 years old is so slow that longer rotations are not believed to be practical. All of these considerations point to the necessity of managing larch in even-aged stands. Furthermore, there can be little doubt that immature stands should be thinned, if merchantable products can be harvested without degrading the stand. Such thinnings or improvement cuttings should follow the usual rules of good forest practice - take out trees of the less desirable species and the trees that are losing in vigor or quality, and reserve enough thrifty stock to utilize the growing space.

Item 4, above, (methods of cutting) requires special and somewhat more extended comments. The comments are concerned primarily with the measures necessary to attain the objective of repeated crops of larch and with the possibilities of "selective" or "selection" cuttings in the type.

Despite recognition that larch is intolerant and that clean cutting or shelterwood cutting will be necessary to permit regeneration, there was a common tendency among the early writers to speak of "selection" cutting. The long-accepted definition that the selection cutting system is intended to create and maintain all-aged forests seems to have been ignored. It is fairly obvious that

most of the writers had no intention of attempting to create all-aged larch forests. To the extent that they advocated protecting and holding advance growth of Douglasfir, they were retreating from the objective of managing larch stands for continuous maximum larch production. The heavy cuttings that were recommended clearly were intended to establish essentially even-aged reproduction. They might better have been called shelterwood cuttings.

Although light reserve stands were generally recommended, considerable importance seems to have been attached to the growth potentialities of the reserved trees. It was believed that these would serve as the basis for a second cut. Evidently, either a very long interval between cuttings or a pretty light second cut was anticipated, because the usual recommendations for volume or number and size of trees in the reserve stands certainly did not indicate rapid growth on merchantable size trees.

It would appear that the bulk of the ingrowth after cutting would be composed of Douglasfir and the more tolerant species· larch occurs chiefly in the upper crown classes. Hence, it seems inconsistent to advocate propagation of larch, yet permit holding of residual stands composed mainly of other species for rather long periods.

The early writers, as stated previously, were fully cognizant of the likelihood that more tolerant species would replace larch. However, the measures suggested for counteracting this tendency seem to have been inadequate. Recommendations were generally limited to what could be required of the logging operators under regular timber sales contracts. These measures included removal of merchantable trees, and elimination of logging slash.

The chief reason why more positive measures were not recommended was that timber harvesting and slash disposal were the only tools at hand. It is evident from some of the early detailed expositions of silvical principles, that it was recognized the measures were not wholly adequate. If we are going to attempt to grow larch with a fair degree of assurance, it will be necessary, in addition to providing for a larch seed supply, to (1) greatly curtail seed production by its competitors, (2) create favorable seedbed conditions, (3) make room for the young larch to thrive, (4) clean and thin young larch stands as needed, and (5) at times, reforest by planting or direct seeding if natural reproduction fails.

The problem of what to do with advance growth of Douglasfir and most other species, especially trees that are approaching merchantable size, is about as difficult now as it was 20 or 30 years ago. It seems wasteful to deliberately destroy such trees. Yet, if advance growth is reserved and protected, it will surely make more difficult,

or perhaps prevent re-establishment of western larch. Here is a question of objectives that only the owner or manager of a forest can decide. If he temporizes by delaying decision at the time when positive action is needed, he is in effect determining that future forest crops will contain less larch. He is doing the same as ruling that future crops of larch aren't worth the sacrifice of advance growth and the effort required to establish larch reproduction.

Weir's early warnings about the seriousness of dwarf mistletoe have not been further studied. The effects of dwarf mistletoe upon growth rate, quality, and mortality are still not well understood. Probably there is much truth in Weir's reports. Dwarf mistletoe certainly deserves increased attention, in planning cutting, marking, and stand improvement operations.

WHERE DO WE GO FROM HERE?

Numerous leads for research projects can be drawn from the material presented in this paper. Several investigations are being made now, and further research will be initiated as rapidly as facilities will permit. Researchers and managers can learn much by observing what has taken place on cut-over lands in the larch-Douglasfir forest type.

One of the major ultimate objectives of silvicultural research is to develop instructions for harvesting and tending stands that will result in perpetuation of the desired species of trees and maintenance of good growth. Another major objective is to learn how to predict growth with reasonable accuracy. The current studies mentioned in the introduction to this paper, such as growth and stand composition, and improvement of seedbed conditions, are steps directed toward the ultimate objectives.

Despite the lack of finality in some of the written material on management of the larch-Douglasfir type, forest managers should not hesitate. They should use their best judgment, and the principles that have been described, in devising methods to meet the goal of continuous production.

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